Intensification Pathways from Farmer Strategies to Sustainable Livelihoods: AHI's Experience

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The bond between natural resources and communities has almost always been filial, though imbalance between utilization and conservation exposed farmers in Africa to extreme poverty and further resource degradation. Subsistence farmers in Eastern Africa are faced with serious decline in soil productivity. They categorize themselves in relation to number & composition of animals, perennial crops, land size and productivity, health and social positions. General strategies towards sustainable livelihoods include enabling their children have proper education, introduction of family planning methods and improvement of agricultural productivity. The last strategy has proven elusive, with few innovations being adopted despite various R&D attempts of both government and non-government institutions. AHI teams across the region have tested various scenarios of participatory and integrative ways to enhance integration of technologies. Farmer research committees (FRC), planning with development agents and scientists, initially focused conservatively on crop varieties. Members now supply seed of selected varieties to others, while researchers learned their selection criteria. With growing confidence, farmers embarked on more complex issues. Multipurpose elephant grass on contours was enthusiastically taken up, followed by farmer experiments with herbaceous and agroforestry legumes. Farmers describe interacting effects: new fodder sources improved dairy production; maize stover is retained for soil fertility; mixing early- and late-maturing maize varieties opened a niche for a legume relay. Some farm-level constraints provoked border conflicts (e.g. construction of soil bunds), which demanded collective management and negotiation of waterways towards developing initial confidence to address higher community issues. The FRCs vision changed to self-reliance through enhanced local innovation, to placing technical demands on the public sector, and to assisting other communities. In this paper, lessons learned across AHI sites about systems intensification scenarios and the roles of research are also discussed.

Introduction

Communities depend on natural resources as a source of their livelihood, including endless array of services for production, utilization, comfort and convenience. The bond between natural resources and communities has almost always been filial, while dynamic and complex, and there can be no divorce from this conjugal bond (Mesfin, 2003). However, due to unbalanced action between utilization and conservation of these natural resources in Africa, farmers and pastoralists are exposed to extreme poverty and further resource degradation.

In contrast to situations elsewhere, per capita food production continues to decline in Africa (World Bank, 1986). Important driving forces are commonly given as climate (frequent drought in SSA), decrease in farm sizes due to population pressure, decline in soil productivity, unfavorable policies, pests and diseases, inappropriate technologies and/or inadequate extension services. Sanchez et al. (1997) argued that increasing food insecurity and poverty in the region is an outcome of soil fertility depletion, and improving the land resource base through integrated nutrient management should be considered as an investment in natural resource capital.

National and international agricultural research institutions, despite their struggle to reverse the situation, are under pressure to justify their research priorities and modify their approaches

in light of food security and natural resource management challenges. Currently, there is no consensus on how to increase real incomes and productivity of smallholders while sustaining the resource base. However, it is recognized that doing so is a more complex task than developing improved technologies solely (Eicher, 1987), in part because small farmers appear reluctant to invest in technologies that do not promise quick and reliable payoffs that satisfy their immediate needs. An integrated farmer-led research agenda is therefore needed where the farmer invests time and some limited resources on partnership and technology development.

Participatory research (PR) approaches provided an opportunity for researchers, extension, development workers and policy makers to understand more about farmers' complex circumstances, problems, needs and priorities. One of the pivotal contributions of PR approaches is the enhancement of inter-disciplinarity among researchers particularly, using an applied systems approach and other diverse disciplinary contributions towards solving complex NRM and livelihood issues (Amede et al. 2004).

This paper synthesizes experiences in the evolution of farmer-led integration of new system components to further sustainable intensification in Eastern and central Africa. The pilot program is hosted by the national agricultural research institutes (NARIs) and the various partners in this process have received support from African Highlands Initiative (AHI[1]), where in contrast to a discipline-oriented reductionist approach and the researcher-led approach originally applied in much FSR-E, the use of participatory tools and integrated strategies has been fostered. The specific objective is to encourage farmers to innovate and build their capacity for collective action in designing, testing and scaling-up technologies and processes that lead to improving the land resource base. The systems intensification research followed a stepwise approach that comprised detailed understanding of the clients and the system, identification of appropriate entry points, promotion of integrated natural resource management agenda, synthesis of dispersed recommendations and information in forms of decision tools to facilitate the decision making capacity of communities and their institutions to respond to the current opportunities and challenges.

Understanding the Clients and Systems

Given the steep slopes, intensive cropping and high rainfall intensity in most of the sites, decline in soil fertility is very apparent. The research teams employed several participatory techniques (Stroud, 1993, Pretty et al., 1995) in order to (1) develop the capacity of farmers and researchers in the area of integrated research, (2) foster partnerships among stakeholders, and (3) foster a change from commodity-oriented to a more holistic and participatory approach where farmers were in the forefront throughout the processes of technology development, dissemination and impact assessment.

At the initial stage of AHI, farmers demanded improved inputs (mainly fertilizers and seed). Later, they conducted varietal trials on major food crops (wheat, teff, beans and maize) and high value crops (coffee), and learned to maintain more than one option selected based on their own criteria. The interest for new technologies enhanced the demand side. Selection criteria varied with the technology, socio-economic strata, gender, market access and others. For example, for teff, the staple bread crop in Ethiopia, women's major selection criterion was colour (white grain fetches more money than red, and is preferred for cooking the local enjera bread), while men considered yield and lodging resistance as the main criteria. By building on that experience farmers started to try more technologies, to innovate, adapt and integrate them into their situations and, in the process, to derive many examples of "win-win" technologies that are useful for various

Table 1. *Farmers' descriptions of indicators and categorisation of wealth groups, Gegecho zone, 1997. (Amede et al., 2001)*

Wealth Strata	Indicators of wealth stratum (Rich to poor)
I	They never face food shortage. Have enough money to buy clothes and other necessary commodity. Own more than 4 *'timad'* (about 1 ha) of land, 2 oxen, 3 milking cows, 3 sheep, 1 donkey and a number of chickens. They have also many matured (unprocessed) enset plants in their homesteads. They have many coffee plants.
II	They have enough food to eat (but not for a long time). Have a minimum of one ox, one milking cow, half hectare of farmland, 1-2 sheep, a donkey and chickens. Some are traders. Have few matured enset plants. Have coffee plants (but not as many as the first strata).
III	Have half hectare of land. They share/possess in common (usually two people) an ox, a cow and a donkey. They can have 1-2 sheep. Have immature (few) enset plants and coffee. Keep few chickens. In general they are engaged in trading maize, travelling to nearby towns to buy maize and sell it in their locality.
IV	They have very small plots (usually less than 0.3 hectares) of land, few coffee and enset plants (their enset plants are very young, i.e. 1-2 years old). They own some sweet potato and a few chickens. The main income source is retail trading of maize flour, ginger, vegetables, salt, tobacco, etc.; they buy and sell only within their locality.
V	These are the poorest of the poor. They lost their land because they could not return money borrowed. They grow no crop, and are daily labourers. The women prepare enset, fetch water, cut and carry grass for others. Men collect fuel wood and sell in nearby small towns, cut and split trees, and sell their labour to get daily food. These are weak (sick or old) and landless people.

cadres of farmers. Notably, not all were subjected to formal experimentation. In some sites, the researcher's role was therefore changing to introducing new ideas rather than design and control of experimentation, to monitoring with the aim of understanding farmers' innovations and evaluations, and to support scaling up. Based on a stratified wealth ranking and social analysis (Table 1), partner farmers were encouraged to work with scientists in participatory NRM research.

[1] The African highlands initiative was conceived as a collaborative program of the national agricultural research institutions (NARIs) of the ASARECA countries and the International Agricultural Research Centres (IARC) to facilitate the marriage between better livelihoods for farmers and sustainable use of the resource base in the East African Highlands.

Various social groups could adopt or reject technologies based on their own perceptions, experiences, risk carrying capacity and perceived benefits. As presented in Table 2, resource-poor farmers resisted the adoption of soil conservation bunds as it would take up land from their small holdings while the rich farmers resisted adopting it due to its very high labour demand.

ENTRY POINTS AS DETERMINANTS OF EXPERIMENTATION AND ADOPTION

Although research in natural resource management needs to take a holistic view as well as acknowledging the complexities and diversity of farming systems, research with farmers should focus on clear issues, addressing critical problems that they have identified and prioritized (Amede et al., 2001). Hence it is important to choose and implement problem-solving entry points on which the possible adoption and dissemination of other NRM technologies by the community would depend on. Researchers involved in AHI used 'entry points' as a strategy to quickly get engaged with the farmers by providing some 'best bet' technical solutions to priority problems. The entry points used differ with social categories and agro ecologies. Detailed analysis of social categorization in Areka (Table1) showed that for relatively resource rich farmers, who have fertile plots and many animals to produce enough manure, high yielding crop varieties were the most preferred entry points, while for the resource poor farmers with degraded land and have limited access to manure preferred soil fertility improving interventions as best entry options (Amede et al., 2001).

EXAMPLES OF SUCCESSFUL ENTRY POINTS WITH WIN-WIN EFFECTS FROM AHI SITES

Case 1: Sweet potato, a major food source planted all year round as a sole or intercrop under maize is damaged by sweet potato butterfly. Controlling the pest is one strategy for increasing household food security. By planting sticky vines of desmodium around sweet potato fields, farmers reduced pest incidence. They have also used desmodium as a protein source for dairy cows (together with carbohydrate-rich elephant grass). This technology became popular among the communities.

Case 2: Farmers used to remove maize stover and wheat straw from outfield plots to use as fuel wood and as mulch for homestead crops. About 80% of the maize stover was used as a source of fuel wood (Amede et al., 2001). By planting Eucalyptus trees three years ago, farmers gained access to better quality fuel wood and this allowed them to now incorporate crop residues in the outfields. Mulch for the enset fields was obtained from the newly planted adjacent banana plants and on-farm trees (e.g. *Cordia*).

Case 3: Enset (the false banana) is the traditional homestead crop that receives the highest proportion of organic resources, mainly from manure and household refuse. The traditional belief is that enset cannot be productive unless it is supplied by organic residue year after year. Some farmers have now started a new strategy by planting enset in the main field. They have designed this change as a driving force (attractant) to transport organic resources to the main and outfields, which have been depleted for years by continual nutrient mining.

Case 4: The farmers who constructed physical soil bunds have integrated the planting of elephant grass (previously a completely unknown species here) to strengthen them. This technology rapidly became very popular, even outside the participating community, for minimizing soil erosion and for increasing the feed capital for the dry season. Farmers think that Elephant grass also reduces the population of maize stalk borers, the most prevalent pest in the area. Researchers will follow this up with further monitoring.

Case 5: Tephrosia and *Canavalia* are effective legume cover crops to restore soil fertility. Farmers started to integrate these LCCs as short-term fallows. *Tephrosia* was adopted in part because

***Table 2.** Perceptions and preferences of various social groups on different soil fertility management options in Ethiopian Highlands (Amede et al., 2001).*

Practice	Rich		Poor	
	Advantage	Disadvantage	Advantage	Disadvantage
Incorporation of crop residue	Soil fertility improvement; Yield increase	Shortage of animal feed	Soil fertility improvement	Fuel shortage
Soil bund	Reduce runoff	High labour demand; U-turn difficult	Erosion control	Take up land
Mulching	Conserve moisture	Reduce fodder	Conserve moisture	Attract termites
Legume cover crops	Soil fertility improvement	No feed value	Protect soil from run off and sun	Competes for land (food)

of farmer interest in its reputation for controlling mole rats, a general pest on many crops. Farmers in Gununo used to invest at least 4 hours to dig out and kill just one or two mole rats.

Case 6: *Sesbania* is a multipurpose tree adopted in many east African countries for feed and fuel. In 2000, farmers in Gununo chopped *Sesbania* leaves and young branches, applied them to sweet potato fields and obtained a substantially higher tuber yield. As sweet potato plants stay on the farm for a longer period than any other annual crop, there is ample time for nutrients to be released. In the following year, the farmers raised more than 500 seedlings and planted them as farm fences as a future source of organic fertilizer. Farmers who purchase fertilizer are expecting a 50% reduction of input costs by using *Sesbania* in biomass transfer.

Case 7: Earlier investigations showed that when early and mid-late maize varieties are grown in mixtures, there is a complementary effect that commonly gives higher yield than either variety alone (Amede, 1995). Farmers have benefited from this technology in two ways: firstly, the early maturing maize component was ready to be consumed as a green cob a month before any other variety was ready and, secondly, farmers obtained a niche to integrate either LCCs or other food crops into the system without affecting maize yield.

Some farmers could consider the temporary free provision of inputs (fertilizers and seeds), while introducing technologies as entry points at the beginning of the project, as a major benefit and this misconception about the project objectives might hinder its sustainability and create bias on the analysis of the attribution of changes in practice and attitudes to the PR approach (Amede etal, 2004).

IMPLEMENTING INTEGRATED APPROACHES

Despite the huge investment in agricultural research by African national programmes and international agricultural research institutions, past efforts have not been sufficient to affect the life of small-scale farmers given a generally reductionist approach lacking orientation towards conservation, development, policy and client participation. Researchers need to have a better understanding of, and integrate the socio-economic, organizational, and cultural issues for various individual and collective resource endowment categories, given that small scale farmers in SSA manipulate and integrate farm components hoping to maximize returns in relation to a complex environment. AHI has therefore promoted a change of researchers' "mind sets" to increase social and economic inputs into the traditional biophysical orientation, advance component/discipline approaches by infusing a systems perspective to achieve multiple goals or outputs by strategic combinations of technologies, and to reverse the trend whereby researchers determine research outputs to that where farmers conduct research and researchers monitor, contextualize the information for a wider range of users, and take up second generation research issues (Stroud, 2000).

After the arrival of the AHI partnership in the region, strategic research in the area took a new direction mainly aimed at increasing the capacity of farmers to analyze the production constraints and find solutions together with researchers. Here, the team involved with AHI is currently targeting integration and natural resource management by involving other partner institutions to a greater degree, having a better understanding of the social group dynamics and the resource endowment of socio-economic strata, fostering a high level of farmer participation and control in the research and development processes, and taking a "larger view" by encouraging involvement of a number of specialists who work beyond their component aiming to improve the system through better integration.

RESEARCH PROCESSES BY RESOURCE-POOR FARMERS

The two wealth groups III and IV (Table 1) are considered by the community as relatively poor, and represent about 70 to 75% of the Gununo community. The main production constraint for these groups mentioned during PRA (PRA report Areka, 1997) was decline in land productivity (also mentioned as the most pressing problem of the whole community). Those farmers who belonged to wealth ranks III and IV did not own livestock; hence they did not have access to manure for their crop fields. To secure the homestead security crops (the root crops enset and taro), farmers have for many years exported crop residues from the outfield (maize, wheat) to the homestead. This traditional nutrient mining led to a buildup of organic matter in the homestead and an extreme depletion in the outfield. Farmers in these categories lacked cash to bring in external inputs (inorganic fertilizers, organic residues, improved varieties) and also lack internal farm inputs (oxen for plowing and seed).

Hence, they usually offer their farm for share cropping to fellow farmers who have more resources. One point worth bearing in mind with share cropping is that while those working the land will want to maximize their harvest, they are less likely to be interested in future productivity and therefore invest less in land care (Amede et al., 2001). Moreover, their land is steep (> 20% slope) and is highly vulnerable to soil erosion with prevalent high intensity of rainfall. These multiple agents lead to some portion of the farm becoming abandoned.

The entry point used with this group was to employ strategic soil and water conservation measures. In the first year, each farmer constructed about 15m of soil conservation bund, the approximate width of individual farm outfields. They strengthened these bunds by planting elephant grass, multipurpose trees and pigeon pea on the top and sides. In one case, Mr Demeke (26 years old) planted wheat on the lower side of his steep land before constructing soil bunds, but reaped a very poor harvest despite applying 25 kg DAP/ha.

However, when he built a soil bund and then replanted the plot with wheat, his yield increased tenfold. He attributed this to the new construction, which prevented both seeds and fertilizer from being washed away (Amede et al., 2001). This impressed farmers in the following year to construct bunds about seven times longer, dividing their land into as many as eight plots following the contour. As the soil bunds were accompanied with forage grasses, farmers pro-

duced a high amount of dry season feed estimated to cover at least 35% of their feed demands. After minimizing the soil loss in these ways, farmers asked for soil improvement systems to increase soil organic matter and to improve nutrient stock and availability.

Since not all farmers own animals, crop residue management and legume cover crops (LCCs) were suggested by farmers and researchers for testing as potential alternative interventions for this farmer category (Table 3). After one season of farmer field schools with LCCs, farmers chose one or more of the seven candidate species (*Trifolium, Stylosanthus, vetch, Canavalia, Mucuna, Crotalaria* and *Tephrosia)* based on their own criteria (Amede et al., 2001). Most farmers of this group voted for *Crotalaria* as it performed well both on good and bad soils. The other measure they took was to stabilize gullies draining water from neighboring fields, firstly by stone blocks to reduce the velocity of run-off and then by planting indigenous trees.

After increasing livestock feed resources through growing grasses and legumes on the soil bunds, farmers asked for credit and bought young calves, partly for fattening and selling, partly to grow into milk cows, and also for recycling feed as manure. They have also planted more Eucalyptus trees to get more cash and fuel wood to reduce negative trade-offs.

The evolution of improved integration among the different farm components was very fast for this group, mainly because their production system relies heavily on internal resource flows and rarely involves external inputs.

RESEARCH PROCESSES BY RESOURCE-RICH FARMERS

These groups are composed of relatively rich farmers who own animals, have managed to produce enough food to cover the household food demand, and are in position to buy external inputs (fertilizers and improved seeds). However, access to new varieties was limited.

At the initial stage of AHI, the priority intervention that this group demanded from researchers was improved inputs (mainly fertilizers and seeds). The farmers conducted varietal trials on four major food crops (wheat, teff, beans and maize) after researchers brought candidate improved varieties from national and international research institutions with proven adaptation record to similar agroecologies.

Farmers tested at least six varieties from each species and selected more than one variety from each species based on their own criteria. Selection criteria varied with the crop, socio-economic strata and gender. For example, for teff (*Eragrostis abyssinica*, the staple bread crop) women's major selection criterion was colour (white grain fetches more money than red, and is preferred for cooking the local *enjera* bread), while men considered yield and lodging resistance as the main criteria. With those varieties introduced to the farming community in 1997, researchers are currently monitoring the fate of selected varieties. As a follow up strategy farmers were provided, at their own request, with training in seed systems to enable them to multiply the promising varieties, share them with nonparticipating fellow farmers and sell to neighboring communities.

Coffee remains as the major cash crop in the region despite recent decreases in price. However, yields had reduced due to coffee berry disease (CBD), the farmers' major concern. The farmers of these groups demanded pesticides in the short term and CBD resistant coffee varieties in the long term. After getting the support of the researchers to solve the pressing production problems (CBD resistant varieties) and witnessing an effective soil erosion control measure from their neighboring farmers (Wealth ranks III and IV), these groups promoted their interest in better integrated farming systems and development of 'win-win' technologies – those that increase productivity and improve NRM.

STRATEGIES TO CATALYZE INTEGRATED NATURAL RESOURCES MANAGEMENT

In some of the sites, like Areka, farmers have long been involved in government and non-government development programs that have tended to be ephemeral and/or based on crisis management. Research has often been peripheral to these programs and farmers largely have been seen as recipients. One successful example often cited is the Wollaita Agricultural Development Unit (WADU), which was integrated but costly apparently, too costly to sustain and to repeat elsewhere.

Development and research organizations are looking for new models to foster an "upward spiral" where the local poor can sustainably improve their livelihoods while maintaining and improving their resource base. Although the work done is largely driven by research interests with the aim to make an impact, the general philosophy is to foster more holistic, integrated and participatory methods as a means to the end. Integrated natural resource

Table 3. *Matching system niches with resource endowment categories to intensify production systems*

Endowment Category	Niche for Intensification
POOREST: Limited land, wage labourers, less diversified, no livestock, no inputs →	Low input labor; legumes & MTPs; higher value cash crop (*CBD coffee*)
MIDDLE: More land, own labour but limiting, some cash crops, some livestock, some trading →	Livestock feed system, intensify manure use, increase diversification - range of options (*inorganic x organic, legume covers, improved crop management)*
MOST: Excess land & rent, hire labour, large livestock, buy inputs, well diversified →	Wood lots, experiment on behalf of others; pay higher wage rates?, micro-enterprise development, livestock feed system, S&W conservation (*soil bunds with grass & compost*)

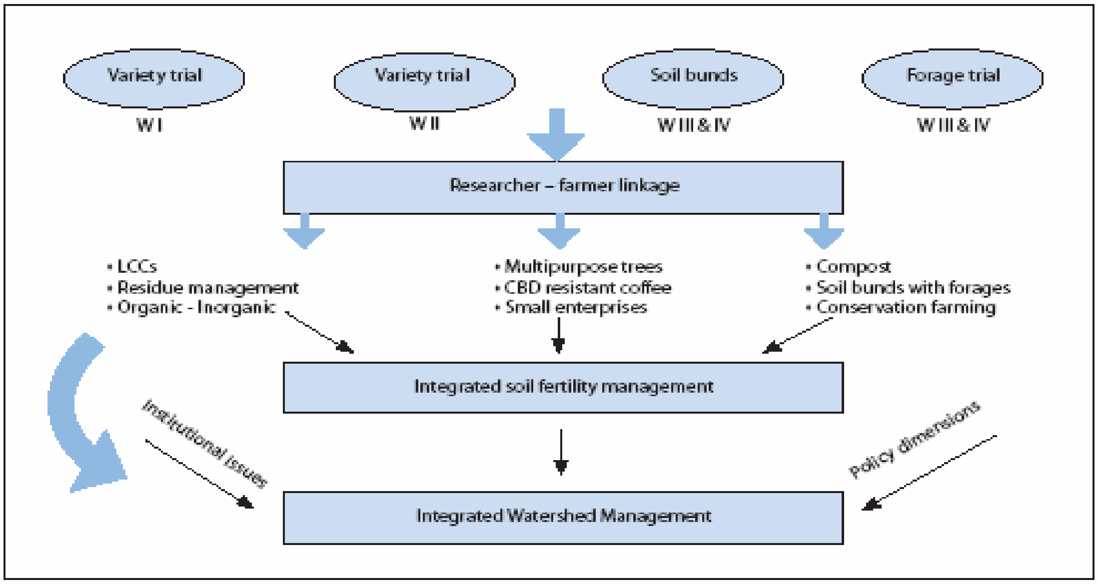

***Figure 1.** The evolution of participatory research from varieties to land management in Areka, Ethiopia.*

management (INRM) at a farm or landscape level can become realistic if (and only if) researchers have sufficient knowledge about the group dynamics and processes, and the driving forces of intensification.

Improving farm productivity has generally remained a challenge mainly because of non-adoption of improved technologies for various reasons. Inclusion of farmers in the research process has been discussed above as a positive step towards increasing adoption. In addition, research methods have been changed. Researchers adopted a "team" and multidisciplinary approach towards solving the farmer-felt problems. They introduced not one, but numerous technologies targeted towards solving soil fertility, income, food and feed problems simultaneously. They incorporated the needs of men, women and various wealth-endowed categories, and fully involved them in an open process for designing trials, choosing and evaluating technologies, and evaluating the programme.

Farmers started to try more technologies, to innovate, adapt and integrate them into their situations and, in the process, to derive many examples of "win-win" technologies that are useful for various cadres of farmers. Notably, not all were subjected to formal experimentation. The researcher role is therefore changing to one of introducing new ideas rather than design and control of experimentation, to monitoring with the aim of understanding farmers' innovations and evaluations, and to support scaling up.

Strategically, different driving forces determine the mode of systems intensification in subsistence farming systems. In general, main determining factors (driving forces) dictating the direction of intensification in the East African highlands are market, climate, land quality, household status and policy. In areas where market access is bad, such as in Areka, (due to inaccessibility, poor policies or otherwise) farmers tend to depend on internal resources. For example, farmers of wealth groups I and II used to buy inorganic fertilizers, but in the year 2000, the price of maize dropped from 100 to 40 Ethiopian birr per 100 kg due to excess production in a year of good rainfall distribution. At the same time, the price of improved seed was about 350 birr and fertilizer 200 birr per 100 kg – an economically unattractive ratio. The following year almost all farmers in Gununo decided not to buy external inputs but to rely on farm-based resources. This proved to be a driving force towards sustainable intensification. With the improved partnership with research and the improved cohesiveness of the community groups, farmers have adapted and combined technologies to achieve this end.

DECISION GUIDES FOR FACILITATING DECISION MAKING

Farmers and other stakeholders are beginning to recognize the need for information management tools which could help them in automating the process of turning the mountains of dispersed data available into useful information. Researchers stemming from various disciplines could give more than five different variants of recommendations and make the farmer more confused than ever to make decisions.

In one case in Ziwai, Southern Ethiopia, researchers who consulted a maize farmer individually on how to maximize the use of maize crop residues suggested burning of the residue to control the maize stalk borer by an entomologist, feeding it to the animals by an animal

scientist, incorporating it to the soil for improving soil fertility by a soil scientist and selling it as a cooking fuel by an economist (personal communication). In this case, the farmers would have made better decisions if the information was gathered, synthesized, analyzed in economic and social terms and suggested to the farmer for possible use.

Whether decision guides could help to facilitate decision making of farmers has been tested on legumes in East African Highlands (Amede and Kirkby, 2004). Food legumes remained to be important components of various farming systems of Eastern Africa, while the attempt to integrate fodder legumes and legume cover crops (LCCs) since 1930s became unsuccessful. Farmers remained reluctant to integrate fodder legumes and LCCs, despite recognizing their benefits as soil fertility restorers and high value feeds, mainly due to community/farmer specific socio-economic factors.

Farmers' participatory research was conducted in Ethiopian Highlands to understand the processes of integration of legumes of different use into mixed subsistent farming systems. Participatory evaluation was first conducted on the agronomic performance and adaptability of eight legumes during the main and small growing seasons.

Following the agronomic evaluation, the perception of farmers to legumes of different use, the socio-economic factors dictating choices and adoption, and potential niches for legume integration into the cropping systems were considered. The final decision of farmers for integrating a non-food legume into their temporal & spatial niches of the system depended on land productivity, farm size, land ownership, access to market and need for livestock feed. The potential adopters of LCCs and forage legumes were less than 7%, while 91% of the farmers integrated the new cultivars of the food legumes. After characterizing the farming systems of other benchmark sites, those indicators were used for development of decision guides to be used for integration of legumes into multiple cropping systems of East African Highlands.

The decision tools developed with one community in Ethiopia were validated in another community with comparable socio-economic characteristics in Kenya. The validation results showed that the decision guide fits well with the current priorities of farmers in general, but few modifications were needed, for example, in households where livestock is an integral component the probability of the household to allocate land for legume cover crops is very rare. Since the land holding in these areas is very small, manure from few animals could suffice to keep soil fertility over years. They favor food and feed legumes over LCCs. In situations when perennial multipurpose legumes (e.g. Calliandra, Sesabania) are grown, they could be grown any where in the farm following soil conservation ditches, a case which was not apparent in Areka. The degree of soil fertility of the farm dictates most of the decisions of farmers on where to place a crop within the farm and other issues come second.

FARMER RESEARCH COMMITTEES AS CHANGE DRIVERS

Farmer and community involvement has proved critical for building farmers' capacity to innovate and experiment and to gain sufficient confidence to continue in their own process of development. In the process of fostering the organization of the farmer research committees (FRC) as the initial interface for interaction, researchers have learned more effective ways of organizing and working with farmers, and for monitoring and evaluating impacts. The majority of the farmer research groups at benchmark sites supported by AHI are involved in experimentation with new technologies, promotion and sales of their preferred technologies, and organizing collective action in response to felt needs.

The FRC recognized that its members' vision has changed with the recent AHI-mediated experiences from one of dependence upon initiatives from outside institutions to one of self-reliance in solving problems. They are now jointly discussing not only short-term needs and solutions, but have recently listed their three main long-term strategies for food security as being: (1) reducing the population pressure through family planning, (2) increasing farm productivity through improving land resource base, and (3) exporting trained labor through education. This change to self reliance also includes placing demands for more options and technologies, placing technical demands on the community and policy makers, and actively assisting other communities in taking up technologies they have found useful. The FRC through sharing experiences is advancing and integrating the technologies well beyond what the researchers initially imagined; thus, dependency is gradually diminishing and the FRC is providing the continuity to the process, regardless of the level of researcher involvement and staff changes.

LINKING NRM WITH MARKET OPPORTUNITIES (CASES FROM INNOVATIVE WOMEN)

The success of many knowledge-intensive technologies like soil and water conservation in Ethiopia heavily depend on the combination of the interventions used to attract farmers to organize themselves, the type and value of the soil conservation stabilizers and the type and amount of the immediate benefits, preferably cash, farmers get out of the intervention. Farmers who were sustainably treating their steep land by constructing hillside terraces were those who planted high value shrubs, fruit trees, and fast growing forages. For example, Ayelech Fikre, an innovative farmer in central Ethiopian highlands was planting gesho (*Rehamnus pertnoides*) also known as hops, which is used to brew local beer and for which there is a high demand in the local market (Million, 2001). When a visiting expert asked her 'Who taught you to do all these different activities?' she replied 'The problem and the market'.

Another innovative woman was Mrs. Romas Haile from Tigrai, Northern Ethiopia (Personal communication). She is a widow, 67, and has no family labor. Her land was far away from the traditional irrigation command area. During recent construction of diversions and canals her farm was almost completely destroyed and covered by stone. On the other hand, she was happy that the water canal was crossing her farm. She decided to remove tones of debris away from her farm alone, which took her at least 3 months. She changed her wheat and barely field to a vegetable garden

irrigating the field using buckets. Her net income increased from debt to about 2000 birr net per annum in the last two years. She is excited that she was able to intensify her farm and improve the productivity of her land through better management using farm residues.

Conclusion

In general, the success of agricultural intervention heavily depends upon the following ingredients:

- Careful selection of entry points, which are quick to solve the major problems of the farmers, which would encourage farmers to be engaged in the research partnership. The next step is to move into more complex issues such as soil and water conservation and organic resource management.
- Increased farmer knowledge on experimentation through facilitation of site visits, farmer to farmer discussions, field days, easy-to-understand brochures, subject matter class trainings, and drama among others
- Integration of ITK and local indicators in the R&D process throughout the research process
- Building mutual confidence among researchers, extension workers, and farmers through strong linkages
- Develop baskets of technological options that are appropriate to all social groups and are gender, and market-oriented
- Frequent supply of knowledge and planting materials, especially for new germplasm of most favored crops and animals
- Formation of FRCs to facilitate farmers' participation and commitment, and evaluate various field experiments
- Supportive research management systems and organization to provide support to local actors, including community facilitation
- Continuity in engaging farmers and their groups, which has eadership and financial implications. ■

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Footnote

1 The African highlands initiative was conceived as a collaborative program of the national agricultural research institutions (NARIs) of the ASARECA countries and the International Agricultural Research Centres (IARC) to facilitate the marriage between betterlivelihoods for farmers and sustainable use of the resource base in the East African Highlands.

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